REMARKS

The Office Action dated August 7, 2007 has been received and carefully noted. The above amendments to the specification, drawings and claims, and the following remarks, are submitted as a full and complete response thereto.

Claims 1-18 are currently pending in the application. Claim 18 has been amended to more particularly point out and distinctly claim the subject matter of the invention. The specification and figures have been amended to more accurately describe the invention. No new matter has been added. Claims 1-18 are respectfully submitted for reconsideration.

The Office Action objected to Figure 2 because the label "22a" should be changed to "122a." Figure 3 was also objected to because the label "101" should be changed to "102." Applicants have amended Figures 2 and 3 to correct the labels, in accordance with the Office Action. As such, Applicants submit that the objection to the figures is rendered moot.

The specification was also objected to because, in paragraph 0050, the label 300 refers to a signal line. While in paragraph 0062 it is stated that "[t]he hard clipper type residual signal is generated by block 400, which corresponds to the block 300 of Figure 3, from the multicarrier signal." Paragraph 0062 contains a typographical error since block 400 should have been indicated as corresponding to block 302 of Figure 3. Accordingly, paragraph 0062 of the specification has been amended to replace "300"

with "302." Additionally, the label "300" has been deleted from Figure 4. Therefore, Applicants submit that the objection to the specification is rendered moot.

The Office Action rejected claims 1-5, 8-12, 15, 17, and 18 under 35 U.S.C. §103(a) as being unpatentable over Hunton (U.S. Patent No. 7,095,798). The Office Action acknowledged that Hunton fails to explicitly disclose applying a least squares function. However, the Office Action then took the position that the correction filters of Hunton are functionally equivalent to the least squares function of the present claims (see Office Action, page 5). This rejection is respectfully traversed for at least the following reasons.

Claim 1, upon which claims 2-7 are dependent, recites a method which includes generating a residual signal from a multicarrier signal, the residual signal representing a difference between the multicarrier signal and a hard-clipped multicarrier signal. The method also includes applying a least squares function to the residual signal for at least one carrier of the multi-carrier signal, thereby generating a minimized residual signal for the at least one carrier, and combining the minimized residual signals and the multicarrier signal.

Claim 8, upon which claims 9-14 are dependent, recites an apparatus comprising a generating unit configured to generate a residual signal from a multicarrier signal, the residual signal representing a difference between the multicarrier signal and a hard-clipped multicarrier signal, and an applying unit configured to apply a least squares function to the residual signal for at least one carrier of the multi-carrier signal, thereby

generating a minimized residual signal for the at least one carrier. The apparatus also includes a combining unit configured to combine the minimized residual signals and the multicarrier signal.

Claim 15, upon which claim 16 is dependent, recites a mobile communication system comprising a transmitter apparatus configured to reduce a peak-to-mean ratio of a multi-carrier signal, a generating unit configured to generate a residual signal from a multicarrier signal, the residual signal representing a difference between the multicarrier signal and a hard-clipped multicarrier signal. The mobile communication system also includes an applying unit configured to apply a least squares function to the residual signal for at least one carrier of the multi-carrier signal, thereby generating a minimized residual signal for the at least one carrier, and a combining unit configured to combine the minimized residual signals and the multicarrier signal.

Claim 17 recites an apparatus including generating means for generating a residual signal from a multicarrier signal, the residual signal representing a difference between the multicarrier signal and a hard-clipped multicarrier signal, applying means for applying a least squares function to the residual signal for at least one carrier of the multi-carrier signal, thereby generating a minimized residual signal for the at least one carrier, and combining means for combining the minimized residual signals and the multicarrier signal.

Claim 18 recites a mobile communication system including transmitting means for reducing a peak-to-mean ratio of a multicarrier signal, and generating means for

generating a residual signal from the multicarrier signal, the residual signal representing a difference between the multicarrier signal and a hard-clipped multicarrier signal. The mobile communication system further includes applying means for applying a least squares function to the residual signal for at least one carrier of the multi-carrier signal, thereby generating a minimized residual signal for the at least one carrier, and combining means for combining the minimized residual signals and the multicarrier signal.

Therefore, embodiments of the present invention relate to the reduction of the peak-to-mean average amplitude in a signal transmitted in a power amplifier, and particularly, but not exclusively, to such reduction in the power amplifier of a multicarrier communication system utilizing an EDGE clipper. Embodiments of the present invention apply a least squares function in order to minimize a cost function with respect to the signal properties that must be maintained and the amount of clipping required for a residual signal that can be used to reduce signal peaks in the composite signal. The use of the least squares function allows embodiments of the present invention to be used in relation to EDGE systems.

As will be discussed below, Hunton fails to disclose or suggest all of the elements of the claims, and therefore fails to provide the advantages and features discussed above.

Hunton discloses a system and method for post filtering peak power reduction in multi-carrier communications systems. The system includes a plurality of communication signal sources each providing a band limited communication signal. A plurality of frequency converters offset the frequency of the plural band limited

communication signals and a first combiner combines the plural frequency offset band limited communication signals to form a band limited multi-carrier communication signal. A peak reduction unit is coupled to receive the band limited multi-carrier communication signal and provide a band limited peak reduced multi-carrier output signal. The peak reduction unit comprises a peak reduction calculation circuit for providing a peak reduction correction signal determined from the communication signal and a signal peak limit value, a plurality of correction filters for filtering the peak reduction correction signal and providing a plurality of band limited peak reduction correction signals, and a second combiner for combining the band limited multi-carrier communication signal and the plurality of band limited peak reduction correction signals to provide a peak reduced multi-carrier output signal band limited in plural bands.

Applicants respectfully submit that Hunton fails to disclose or suggest all of the elements of the present claims. For example, Hunton does not disclose or suggest "applying a least squares function to the residual signal for at least one carrier of the multi-carrier signal, thereby generating a minimized residual signal for the at least one carrier," as recited in claim 1 and similarly recited in claims 8, 15, 17, and 18.

As mentioned above, embodiments of the invention relate to the reduction of the peak-to-mean average amplitude in a signal transmitted in a power amplifier and, particularly, but not exclusively, to such reduction in the power amplifier of a multicarrier communication system utilizing an EDGE clipper. The introduction of amplitude modulating pulses into EDGE systems is known to be particularly undesirable

effect on other signal properties (see Specification, pages 5-6). Embodiments of the present invention apply a least squares function in order to minimize a cost function with respect to the signal properties that must be maintained and the amount of clipping required for a residual signal that can be used to reduce signal peaks in the composite signal. As discussed in the present specification, the use of the least squares functions allows embodiments of the invention to generate an error signal that resembles the hard clipper type residual signal as much as possible, while fulfilling the additional constraints of frequency spectrum, peak error vector magnitude (EVM) and root mean squared EVM (see Specification, paragraphs 0044-0049). As illustrated in Figures 1-3, the outputs of the least squares fitting functional block 306 may then be filtered in complex filters 106a-106d (Specification, page 10).

As outlined above, Hunton describes a system for post filtering signal peak reduction for use in a multicarrier communication system. An algorithm processor calculates a correction vector C for each sample of the signal S, according to the described equation. Correction vector C is used to produce a signal V_c which represents the difference between the input signal stream S and a version of S hard limited to the amplitude L (i.e. a hard clipped version of the input signal). One or more correction filters arranged in parallel are provided to filter the signal V_c to ensure that when it is combined with the signal stream S the frequency requirements for the output signal are maintained. Each correction filter path is gain adjusted by a constant g_n to prevent

excessive suppression of signal peaks, and to allow the burden of peak power suppression to be distributed to each allocated transmit band.

The Office Action acknowledges that Hunton fails to disclose applying a least squares function to the residual signal for at least one carrier of the multicarrier signal (Office Action, page 5). The Office Action then asserted that the plurality of correction filters of Hunton is functionally equivalent to the least squares function of the claimed invention. Applicants respectfully disagree. Applicants submit that, at most, the plurality of correction filters 170 of Hunton may be similar to the complex filters 106a-106d of the present invention. In Hunton, the correction filters are used to ensure compliance of the correction signal with the frequency specifications of the output signal. However, the correction signal supplied to the filters differs between Hunton and embodiments of the claimed invention.

According to Hunton, a hard clipped correction signal is provided to a number of filter channels each comprising a multiplier and a correction filter. The gain constants provided to each multiplier control the burden of peak power suppression distributed to each allocated transmit band. The gain constants are set at design time and must be carefully chosen to ensure adequate performance for any correction signal.

According to embodiments of the claimed invention, on the other hand, the correction signal to be applied to each channel, for example x_1 to x_4, may be individually generated using the least squares fitting function to approximate a hard clipped correction signal. The use of a least squares function allows the fitted correction signal to be

optimized with regard to a cost function to ensure compliance with signal specification requirements. Therefore, the signal supplied to filters 106a-106d is similar to a hard clipped correction signal but has already been optimized, for instance, with regard to frequency specification and EVM requirements. This is clearly different from simply distributing the power suppression across the carrier signals in a fixed ratio, according to certain constant values. Rather, the cancellation signal itself may be optimized to ensure signal requirements are met, thereby leading to a more flexible method or system for reducing the PAIR ratio of a multicarrier signal and further improving efficiency and performance of the system.

Therefore, for at least the reasons discussed above, Applicants respectfully submit that Hunton fails to disclose or suggest "applying a least squares function to the residual signal for at least one carrier of the multi-carrier signal, thereby generating a minimized residual signal for the at least one carrier," as recited in claim 1 and similarly recited in claims 8, 15, 17, and 18. Accordingly, Applicants respectfully request that the rejection of claims 1, 8, 15, 17, and 18 be withdrawn.

Claims 2-5 and 9-12 are dependent upon claims 1 and 8, respectively. As such, claims 2-5 and 9-12 should be allowed for at least their dependence upon claims 1 and 8, and for the specific limitations recited therein.

Claim 16 was rejected under 35 U.S.C. §103(a) as being unpatentable over Hunton in view of Wright (U.S. Patent No. 7,061,990). The Office Action took the position that Hunton discloses all of the elements of the claim, with the exception of the generating

unit, applying unit and combining unit being implemented in a GSM EDGE mobile communication system. The Office Action then cited Wright as allegedly curing these deficiencies in Hunton. This rejection is respectfully traversed for at least the following reasons.

Hunton is discussed above. Wright discloses a method and apparatus for reducing a peak to average signal level exhibited by single or by multicarrier multibearer waveforms.

Claim 16 is dependent upon claim 15, and inherits all of the limitations thereof. As discussed above, Hunton fails to disclose or suggest all of the elements of claim 15. Furthermore, Wright fails to cure the deficiencies in Hunton with respect to claim 15, as Wright also fails to disclose or suggest applying a least squares function to the residual signal for at least one carrier of the multicarrier signal. Therefore, the combination of Hunton and Wright fails to disclose or suggest all of the elements of claim 16.

Claims 6, 7, 13, and 14 were objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form. Applicants submit that claims 6, 7, 13, and 14 should be allowed in their current form since the claims upon which they depend should be allowed for at least the reasons outlined above. As a result, claims 6, 7, 13, and 14 have not been amended to be in independent form.

Applicants respectfully submit that Hunton and Wright, whether viewed individually or combined, fail to disclose or suggest all of the elements of the claimed invention. These distinctions are more than sufficient to render the claimed invention

unanticipated and unobvious. It is therefore respectfully requested that all of claims 1-18 be allowed, and this application passed to issue.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the applicants' undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, the applicants respectfully petition for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,

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Enclosures: Replacement Sheets Figs 2-4